Agriculture Canada

Research Branch
Direction générale de la recherche

Contribution 1983-5E

SIMWEEVIL/SIMABL

An IPM monitoring system for the alfalfa weevil and alfalfa blotch leafminer

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SIMWEEVIL/SIMABL

An IPM monitoring system for the alfalfa weevil and alfalfa blotch leafminer

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Original date: March 1981
Revisions: October 1981
May 1982 (as SIMWEEVIL/SIMABL)
Source language: VAX/VMS Command language March 1980
VAX/VMS FORTRAN April 1980
Implementation: Agriculture Canada DEC VAX-11/780 System B

Note: This document supersedes "A user's guide to SIMWEEVIL — A monitoring system for the alfalfa weevil"

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Research Branch
Agriculture Canada
1983

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Produced by Research Program Service

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Summary

This bulletin documents a computerized multipest-crop system of alfalfa IPM in southern Ontario. Termed SIMWEEVIL/SIMABL, the system monitors seasonal development of the alfalfa weevil and the alfalfa blotch leafminer together with their host crop, and automatically issues advisories that describe actions to be taken by field scouts and/or growers. It is implemented through the Agriculture Canada, VAX 11/780 computer and is available on-line to agencies throughout Ontario.

Résumé

Le présent communiqué décrit un système informatisé de lutte intégrée contre les parasites de la luzerne pour le Sud de l'Ontario. Le système, appelé SIMWEEVIL/SIMABL, surveille la croissance saisonnière des populations de charançons de la luzerne et d'agromyzes de la luzerne ainsi que le développement de leur plante hôte et émet automatiquement des avis aux agents d'avertissement et aux agriculteurs en leur indiquant les mesures à prendre. Ce système est mis en oeuvre grâce à l'ordinateur VAX 11/780 du ministère de l'Agriculture du Canada et tous les organismes de l'Ontario peuvent y accéder directement.

1. Description

SIMWEEVIL/SIMABL is a collection of data files and procedures which were designed to monitor seasonal development of the alfalfa weevil, Hypera postica (Gyll.), and the alfalfa blotch leafminer, Agromyza frontella (Rond.), together with their host crop. The system was developed for use in alfalfa pest management and has particular reference to crop and pest conditions in southern Ontario.
Seasonal development is calculated using the temperature-driven polynomial growth algorithm of Harcourt and Yee (1982). For the insects, the polynomial coefficients were derived from Guppy and Mukerji (1974) and Guppy (1981). For the crop, they were derived from heat unit requirements for each stage (Harcourt, unpublished). Input data consist of daily maximum and minimum air temperatures (Celsius) as well as long term values which are filed and stored by location.
Temperatures may be entered at any time throughout the field season beginning on 1 April and may be entered on a daily or periodic basis, e.g. following a weekend.
In addition, 5-day forecast data may be used for predictive purposes and then overwritten by actual values.
Historical data are used for missing entries; however, the number of actual values should be maximized since no year is really typical.

Output consists of the location name, a status report and an advisory message. The status report is composed of 4 items : (1) the date, (2) the alfalfa growth stage and expected number of days until the next stage,

(3) the weevil life stage together with its cumulative development within that stage and the expected number of days until peak of the next, and (4) the alfalfa blotch leafminer life stage together with its cumulative development within that stage and the expected number of days until peak of the next. The advisories describe actions to be taken by a field scout and/or grower.

SIMWEEVIL/SIMABL divides the life cycle of the weevil into 7 stages : egg, instar 1, instar 2, instar3, instar 4, cocoon (combined prepupal and pupal stages), and adult. It divides the life cycle of the blotch leafminer into 4 stages : adult, egg, larva and pupa. It recognizes 7 stages of crop development : prebud, early bud, mid bud, late bud, early bloom, late bloom, and full flower; these stages correspond to those of James (1971).

SIMWEEVIL/SIMABL is an extension of the SIMWEEVIL package (Yee and Harcourt (1982)). It monitors development of the two pests throughout their active seasons. However, alfalfa development is not monitored beyond full bloom of the first crop since development of subsequent crops is dictated by dates of harvest. The weevil advisories pertain to the first crop of alfalfa and its early stages of regrowth. The leafminer advisories pertain to alfalfa produced in a three-cut system.

REFERENCES

Guppy, J. C. 1981. Bionomics of the Alfalfa Blotch Leafminer Agromyza frontella (Diptera:Agromyzidae) in Eastern Ontario. Can. Entomol. 113:593-600

Guppy, J. C. & M. K. Mukerji. 1974. Effects of Temperature on Developmental Rate of the Immature Stages of the Alfalfa Weevil, Hypera postica (Coleoptera:Curculionidae). Can. Entomol. 106:93-100

Harcourt, D. G. & J. M. Yee. 1982. Polynomial Algorithm for Predicting the Duration of Insect Life Stages. Environ. Entomol. 11:581-584

James, C. 1971. A manual of assessment keys for plant diseases. Canada Dept. Agric. Publ. 1458.

Yee, J. M. & D. G. Harcourt. 1982. A user's guide to SIMWEEVIL A monitoring system for the alfalfa weevil. Ottawa Research Station, Agriculture Canada Ministry of Supply and Services.

2. Data Files and Procedures

2.1 Data Files - direct access, relative

These files contain "local" data, that is, data which are specific to a location such as temperature. In the following descriptions the symbol 'LOCATION' represents a place holder for the actual location name, for example OTTAWAS.DAT

'LOCATION'S.DAT	record 1	addresses of alfalfa, weevil and blotch leafminer data blocks, and end-of-file
	r = address of a data block	
	record r	current life stage (CLS) number, CLS name, cumulative development units (CDU), last date of processing, predicted days to next stage
	record r+k	life stage k, date of predicted peak, date of observed peak
'LOCATION'T.DAT	record 1	daily maximum temperatures
	record 2	daily minimum temperatures

2.2 Procedures

SIMWEEVIL.COM	command procedure which supervises the execution of the SIMWEEVIL/SIMABL programs
READSITE.COM	prompts for location to be analyzed, searches for location in its internal list, if location is new the user is so informed and the no-process condition is set

ENTERDATA.EXE prompts for temperature data, stores data in 'LOCATION'T.DAT

DEVELOP.EXE fetches temperature and life stage data, executes development algorithm, predicts number of days to next life stage, stores updated life stage variables in 'LOCATION'S.DAT

REPORT.EXE reports the alfalfa, weevil and blotch leafminer life stage at the location being analyzed up to midnight of the present day, prints advisory

3. Using SIMWEEVIL/SIMABL

3.1 User execution

1. log-on to Agriculture Canada VAX system B
2. wait for the command prompt $
3. start the command procedure SIMWEEVIL by typing the appropriate string
   a. Ottawa Res. Stn. - @SIMWEEVIL (RETURN)
   b. OMAF - WEEVIL (RETURN)
   c. others - @[AG338000]SIMWEEVIL (RETURN)

   Note : The location name may be inserted after SIMWEEVIL or WEEVIL and before RETURN
4. answer the prompts (see 3.2.2)
5. logoff

3.2 Details on data input

3.2.1 The location parameter is an optional character string naming the location to be analyzed. If the string is omitted, the command procedure READSITE will prompt for it. Location names must not contain embedded

blanks and should not be longer than 8 alphanumeric characters. Longer names will be truncated to the first 8 characters.

example : $@SIMWEEVIL OTTAWA (RETURN)

3.2.2 The prompts indicate the type of input data required (character or numeric). Responses must correspond to the data type. Spaces should be avoided except where necessary. Dates are entered as a 4 digit integer (MMDD); e.g. May 4 == 504

Prompts and appropriate responses :

a. prompt : YOUR LOCATION?

response : name of location

b. prompt : ENTER Y(ES) IF YOU HAVE YESTERDAY'S TEMPS.

response : Y for yes
RETURN or any other character for no

c. prompt : ENTER MAX AND MIN TEMP.

response : max and min in C, separate values with a space or comma

d. prompt : ENTER Y(ES) IF YOU HAVE OTHER DAY'S TEMPS.

response : as in b.

e. prompt : DATE-MONTH DAY

response : 4 digit integer representing month and day, e.g. April 7 is entered 407
if there are nomore data to be entered type a RETURN

f. prompt : ENTER Y[ES] FOR ANOTHER LOCATION

response : Y or T for another location,
type a RETURN for system exit

3.3 Comments

Input errors will usually result in an error message and a reprompt. The number of error/reprompt cycles is limited to prevent an infinite loop. Any system error messages should be reported to the SIMWEEVIL/SIMABL manager as these may result from program 'bugs'. Such bugs may cause misinformation to be written to the data files.

Avoid running SIMWEEVIL before temperature data have been gathered. Entering past data after a run may introduce errors in the predicted date of the peak of a life stage.

The status report should start printing within 10 seconds after the last temperature prompt has been answered.

4. Information for the SIMWEEVIL/SIMABL Manager

4.1 Procedure files

a. SIMWEEVIL.COM is placed in the HOME directory of the Ottawa Research Station account

b. All other procedures should be placed in the subdirectory [.S.SIMWEEV] . If they are placed in another subdirectory the global variable DIRECT in SIMWEEVIL.COM must be reassigned accordingly.

c. DEVELOP, ENTERDATA, REPORT must be compiled and and linked. The .OBJ files should be deleted to save space. REPORT must be compiled with the qualifier /CONTINUATIONS=99

4.2 Data files

All data files must be placed in the same subdirectory as indicated in 4.1b. The file protection code must be set so that WORLD is at least RW ; otherwise, non-AG3380000 users cannot update (write to) the data files. The program UTIL will convert editor constructed (sequential) files into relative, direct access files used by the SIMWEEVIL/SIMABL programs.

a. 'LOCATION'T.DAT recl=(number of days in season)+1

editor file format : all records 2F6.1

contents : each record contains a max/min temp.

The LOCATION'T.DAT file for a site is created by WRITEing the editor file to the file 'LOCATION'T using the program UTIL and UTILITY code 1.

b. 'LOCATION'S.DAT recl=8

editor file format :

rec 1	3I3
rec 2	I3,A16,F6.4,2I3
rec 3<=k<=10	A16,2I5
rec 11	as rec 2
rec 12<=k<=21	as recs 3-10
rec 22	as rec 2
rec 23<=k<=57	as recs 3-10

The 'LOCATION'S.DAT files for the different sites are initialized by WRITEing the file LOC to the file 'LOCATION'S using the program UTIL and code 2. If the season start is not April 1 then change 401 to the appropriate date and change 91 to

(Julian date of season start)-1. For example, if Ottawa season start is April 21 then 401 becomes 421 and 91 becomes 111 in the OTTAWAS.DAT file. The ABL adult emergence stage logically belongs in the same generation as the pupa generation, and the programs follow this convention. For purposes of reporting advisories the adult emergence stage is incorporated into the next generation.

contents of LOC.DAT (record 1 = 2 11 22 58)


```
column
12345678901234567890123456789012345

  2 11 22 58
  1          PRE BUD0.0000 91 10
          PRE BUD  401    0
        EARLY BUD    0    0
          MID BUD    0    0
         LATE BUD    0    0
      EARLY BLOOM    0    0
       LATE BLOOM    0    0
      FULL FLOWER    0    0
     NOTHING ELSE 1231 1231
  1              EGG0.0000 91 10
              EGG  401    0
            HATCH    0    0
 LARVAL INSTAR 1     0    0
 LARVAL INSTAR 2     0    0
 LARVAL INSTAR 3     0    0
 LARVAL INSTAR 4     0    0
           COCOON    0    0
 ADULT EMERGENCE     0    0
            ADULT    0    0
         NO OTHER 1231 1231
  6          PUPA G0-.4000 91 10
         ADULT G0    0    0
           EGG G0    0    0
         HATCH G0    0    0
         LARVA G0    0    0
   LARVA DROP G0     0    0
          PUPA G0  401    0
 ADULT EMERG. G1     0    0
         ADULT G1    0    0
           EGG G1    0    0
         HATCH G1    0    0
         LARVA G1    0    0
   LARVA DROP G1     0    0
          PUPA G1    0    0
 ADULT EMERG. G2     0    0
         ADULT G2    0    0
           EGG G2    0    0
         HATCH G2    0    0
         LARVA G2    0    0
   LARVA DROP G2     0    0
          PUPA G2    0    0
 ADULT EMERG. G3     0    0
         ADULT G3    0    0
           EGG G3    0    0
         HATCH G3    0    0
         LARVA G3    0    0
   LARVA DROP G3     0    0
          PUPA G3    0    0
 ADULT EMERG. G4     0    0
         ADULT G4    0    0
           EGG G4    0    0
         HATCH G4    0    0
         LARVA G4    0    0
   LARVA DROP G4     0    0
          PUPA G4    0    0
         NO OTHER 1231 1231
```

4.3 Placing a New Location in the System

SIMWEEVIL/SIMABL is currently set up to process the locations Guelph, Ottawa, Simcoe, Smithfield, Kemptville and a dummy location TEST. If a new location, call it Newsite, is to be processed then READSITE.COM must be modified and two data files, NEWSITET.DAT and NEWSITES.DAT, must be created.

READSITE is modified by adding the line $LOC7:=NEWSITE and by changing the line $LOCLIM=6 to $LOCLIM=7 . Both of these lines are located at the beginning of the program (see section 6).

NEWSITET.DAT is created in two steps. Step 1 is to use the editor to create a sequential file of daily temperatures. Each record contains one max/min pair and there must be one record for each day of the season. The temperatures entered are arbitrary; however, since they are used for development predictions historical temperatures are recommended. For instance, 10-year normals or the previous year's observations may be employed. Step 2 is to use the program UTIL to write the sequential file to the relative file NEWSITET . NEWSITET.DAT must not exist already. The old sequential file may be deleted to save space.

NEWSITES.DAT is created by using UTIL to write the sequential file LOC to NEWSITES . If the season start for Newsite is not April 1, then LOC must be changed before using UTIL (see 4.2b). NEWSITES.DAT must not exist already.

4.4 Extending the SIMWEEVIL/SIMABL season

The SIMWEEVIL/SIMABL season may be extended beyond September 30 by changing the parameter values in the programs shown in the following table.

Extending the SIMWEEVIL/SIMABL Season

Program	Parameter(s)	Location of Parameter(s)
DEVELOP	LAST	MAIN
		subroutine ACCUMULATE
ENTERDATA	FINISH	MAIN
	LAST	MAIN
		subroutine INDATA
REPORT	FINISH	MAIN
UTIL	LAST	MAIN

The parameter FINISH is the date of the end of the season expressed as a 4 digit integer (MMDD), e.g. for October 31, FINISH =1031 . The parameter LAST is the Julian date (366 day year) of the end of the season, e.g. for October 31, LAST = 305 .

Make sure the 'LOCATION'S files contain enough life stages to accomodate the longer season. If more stages are added, the addresses (record 1) must be corrected. In addition program REPORT, subroutine ADVISE must be revised to accomodate the additional stages.

. Example Session

The following session was conducted on the Ottawa Research Station account. The blank line after the prompt for YESTERDAY'S TEMPS. is really a carriage return indicating a negative (NO) response. Similarly the blank line after the third DATE-MONTH DAY prompt is a carriage return indicating no more data are to be entered. As shown by the time stamps at the beginning and end of the session, the entire process took less than three minutes.

```
enter class 21
class 021 start

Username: AG3380000
Password:
        Welcome to VAX/VMS Version V2.5 on node _OTTB::


  29-MAY-1982 14:41:36

  User [024,002] has 5741 blocks used, 259 available,
  of 6000 authorized and permitted overdraft of 100 blocks on USER1

$ @SIMWEEVIL TEST
 ENTER Y(ES) IF YOU HAVE YESTERDAY'S  TEMPS.

 ENTER Y(ES) IF YOU HAVE OTHER DAY'S  TEMPS.
Y
 DATE-MONTH DAY
527
ENTER MAX AND MIN TEMP.
22.5,10.0
 DATE-MONTH DAY



LOCATION : TEST
STATUS AS OF 00:00H 29-MAY-82



ALFALFA CROP STAGE :         EARLY BUD
                            MID BUD EXPECTED WITHIN  4 DAYS.
MAXIMUM PROTEIN LEVELS HAVE BEEN REACHED.



ALFALFA WEEVIL STAGE :  LARVAL INSTAR 1 ; DEVELOPMENT=   2 %
                     LARVAL INSTAR 2 PEAK EXPECTED WITHIN  4 DAYS.
CHECK FOR LARVAL FEEDING DAMAGE IN FOLIAGE. IF 25% OF STEMS
SHOW FEEDING DAMAGE IN THE TIPS, HARVEST OR SPRAY IMMEDIATELY.



ALFALFA B. L.  STAGE :          ADULT G1
                            EGG G1 PEAK EXPECTED WITHIN  3 DAYS.
PINHOLING WILL BE EVIDENT IN AREAS OF HIGH INFESTATION.
                STARTING IN  1 DAYS
USE EARLY WARNING SYSTEM TO ARRIVE AT A TREAT/NOTREAT DECISION.
IF NOTREATMENT INDICATED, RESAMPLE IN 3 OR 4 DAYS. IF TREATMENT
INDICATED, HARVEST IMMEDIATELY IF CROP HAS REACHED BUD STAGE
AND THERE IS SUFFICIENT BULK. OTHERWISE SPRAY WITH A PESTICIDE.



ENTER Y[ES] FOR ANOTHER LOCATION.
END OF SIMWEEVIL.
$ LOGOFF
+@AG3380000    logged out at 29-MAY-1982 14:44:23.07
```

6. Program Listings

SIMWEEVIL/SIMABL Programs

6.1 SIMWEEVIL.COM

6.2 READSITE.COM

6.3 ENTERDATA.FOR

6.4 DEVELOP.FOR

6.5 REPORT.FOR

Utility Program

6.6 UTIL.FOR

```
$!    6.1  SIMWEEVIL.COM
$!
$!COMMAND PROCEDURE FOR ALFALFA WEEVIL DEVELOPMENT
$!
$!INITIALIZE
$ ON ERROR THEN GOTO L
$ DIRECT:==[AG3380000.S.SIMWEEV]
$ TFIL:==" "      !GLOBAL VARIABLES, REASSIGNED IN READSITE
$ SFIL:==" "
$!
$L:
$!
$  ASSIGN/USER SYSSCOMMAND FOR005
$  @'DIRECT'READSITE 'P1' 'P2' 'P3' 'P4' 'P5' 'P6' 'P7' 'P8'
$  IF SFIL .EQS. TFIL THEN GOTO AGAIN
$!
$  ASSIGN/USER SYSSCOMMAND FOR005
$  ASSIGN/USER 'DIRECT''TFIL' TMP
$  ASSIGN/USER 'DIRECT''SFIL' LFSTG
$  RUN 'DIRECT'ENTERDATA
$!
$  ASSIGN/USER 'DIRECT''TFIL' TMP
$  ASSIGN/USER 'DIRECT''SFIL' LFSTG
$  RUN 'DIRECT'DEVELOP
$!
$  WRITE SYSSOUTPUT "LOCATION : ''LOCATION'"
$!
$  ASSIGN/USER 'DIRECT''SFIL' LFSTG
$  RUN 'DIRECT'REPORT
$!
$AGAIN:
$! RESETS COMMAND PROCEDURE PARAMETERS.
$  P1:=""
$  P2:=""
$  P3:=""
$  P4:=""
$  P5:=""
$  P6:=""
$  P7:=""
$  P8:=""
$! PROMPTS FOR ANOTHER SITE, IF NONE THEN EXIT SIMWEEVIL.
$  INQUIRE/NOPUNC ANOTHER "ENTER Y[ES] FOR ANOTHER LOCATION."
$  IF ANOTHER .EQS. "Y" THEN GOTO L
$  WRITE SYSSOUTPUT "END OF SIMWEEVIL."
$!
$!END OF SIMWEEVIL COMMAND PROCEDURE
```

```
100    $!    6.2  READSITE.COM
200    $!
300    $!COMMAND PROCEDURE TO READ SITE NAME. IF SITE IS NEW, THEN USER
400    $!IS INFORMED THE SITE IS NOT IN THE EXTENSION PROGRAM.
500    $!
600    $!LOCATIONS ON LINE
700    $ LOC1 :=SIMCOE
800    $ LOC2 :=SMITHFIE
900    $ LOC3 :=GUELPH
1000   $ LOC4 :=OTTAWA
1100   $ LOC5 :=KEMPTVIL
1200   $ LOC6 :=TEST
1300   $ LOCLIM=6
1400   $ K=0
1500   $!MERGE EMBEDDED BLANKS IN LOCATION NAME (IF PASSED AS PARAMETERS)
1600   $ SITE:='P1''P2''P3''P4''P5''P6''P7''P8'
1700   $ IF SITE .EQS. "" THEN GOTO RL0
1800   $ GOTO RL1
1900   $ RL0:
2000   $      INQUIRE/NOPUNC SITE "YOUR LOCATION? "
2100   $      IF SITE .EQS. "" THEN GOTO RLW
2200   $      LEN='FSLENGTH(SITE)
2300   $      LOC='FSLOCATE(" ",SITE)
2400   $      IF LOC .GE. LEN THEN GOTO RL1
2500   $ RLW:
2600   $      WRITE SYS$OUTPUT "LOCATION MUST BE ONE WORD."
2700   $      K=K+1
2800   $      IF K .LE. 5 THEN GOTO RL0
2900   $      WRITE SYS$OUTPUT "ERROR LIMIT EXCEEDED. PROCEDURE EXIT."
3000   $      EXIT
3100   $ RL1:
3200   $!     TRUNCATE LOCATION NAME TO 8 CHARACTERS
3300   $      LEN='FSLENGTH(SITE)
3400   $      IF LEN .GT. 8 THEN LEN=8
3500   $      LOCATION:=='FSEXTRACT(0,LEN,SITE)
3600   $ C=1
3700   $ SITELOOP:
3800   $!     SEARCH FOR SITE NAME IN INTERNAL LIST
3900   $      IF LOCATION .EQS. LOC'C' THEN GOTO OK2
4000   $      C=C+1
4100   $      IF C .LE. LOCLIM THEN GOTO SITELOOP
4200   $ NEWSITE:
4300   $      WRITE SYS$OUTPUT " "
4400   $      WRITE SYS$OUTPUT "YOUR LOCATION IS NEW AND THUS IS NOT INCLUDED"
4500   $      WRITE SYS$OUTPUT "IN THE WEEVIL/ABL MONITORING PROGRAM. CALL THE"
4600   $      WRITE SYS$OUTPUT "MONITORING PROGRAM AT 613-996-7676 AND ASK"
4700   $      WRITE SYS$OUTPUT "FOR THE SIMWEEVIL/SIMABL MANAGER."
4800   $      WRITE SYS$OUTPUT " "
4900   $      TFIL:==NEWLOCATION
5000   $      SFIL:==NEWLOCATION
5100   $      GOTO ENDLABEL
5200   $ OK2:
5300   $      TFIL:=='LOCATION'T.DAT;1
5400   $      SFIL:=='LOCATION'S.DAT;1
5500   $ ENDLABEL:
5600   $!END OF READSITE COMMAND PROCEDURE
```

```
C       6.3     ENTERDATA.FOR
C
C       PROGRAM ENTERDATA
C
C       THIS PROGRAM ACCEPTS TEMPERATURE DATA FROM THE
C       TERMINAL. THE DATA ARE ENTERED INTO THE
C       TEMPERATURE FILE OF THE CURRENT LOCATION.
C
C
        LOGICAL FUNCTION PROMPT(PMT)
C       INQUIRES WHETHER OR NOT USER HAS TEMPERATURE DATA TO ENTER
C       RETURNS LOGICAL TRUE IF USER HAS DATA TO ENTER,
C       OTHERWISE RETURNS LOGICAL FALSE
           CHARACTER*(*) PMT
           INTEGER K
           CHARACTER ANS*1
C
           K=0
 100       WRITE(6,*) ' ENTER Y(ES) IF YOU HAVE',PMT,' TEMPS.'
           READ(5,501,ERR=200) ANS
 501       FORMAT(A1)
           GOTO 300
 200       WRITE(6,*) ' ERROR.'
           K=K+1
           IF (K .LE. 4) GOTO 100
           WRITE(6,*) ' ERROR LIMIT EXCEEDED. NOMORE DATA ASSUMED.'
 300       PROMPT=ANS.EQ.'Y'
           RETURN
           END
C          END OF LOGICAL FUNCTION PROMPT
C
C
        SUBROUTINE RESET(START,FINISH,MINDAY,NORGS,ORGOFF)
C          RESETS LIFE STAGE VARIABLES IF TEMPERATURE DATA FOR A DAY (MINDAY)
C          PREVIOUS TO LAST ACCESS DATE ( MRD ) ARE ENTERED, RESET AS
C          FOLLOWS : 1. CSTG = LIFESTAGE IN PROGRESS ON MINDAY
C                    2. CDU  = 0.0
C                    3. DAY  = DAY ON WHICH CSTG STARTED DEVELOPMENT
C
           INTEGER MINDAY,PD,OBS,CLS,NXD,DAY,I,MONTH(1:12),DTOM(1:366)
           INTEGER START,FINISH,ORG,NORGS,ORGOFF(1:*)
           REAL    CDU
           CHARACTER CSTG*16
           COMMON /CAL/DTOM,MONTH
C
           DO ORG=1,NORGS
                CLS=0
C
C               SEARCH FOR LAST STAGE WHICH COMPLETES DEVELOPMENT
C               BEFORE MINDAY (INCLUSIVE)
 100            CLS=CLS+1
                READ(12,REC=CLS+ORGOFF(ORG)) CSTG,NXD,OBS
                NXD=MAX(START,MIN(FINISH,NXD))
                I=NXD/100
                DAY=MONTH(I)+NXD-100*I
                IF (DAY .LT. MINDAY) GOTO 100
                CLS=MAX(1,CLS-1)
C
C               ABL PUPAE OVERWINTER, SO SPRING (INITIAL) STAGE
C               IS PUPA, THUS MINIMUM CLS FOR ABL IS 6
                IF (ORG .EQ. 3) CLS=MAX(6,CLS)
```

```
C
      READ(12,REC=CLS+ORGOFF(ORG)) CSTG,PD,OBS
      PD=MAX(START,MIN(FINISH,PD))
      I=PD/100
      DAY=MONTH(I)+PD-100*I-1
      CDU=0.0
C
C     ABL OVERWINTERING PUPAE GIVEN NEGATIVE DEVELOPMENT AS
C     OF STARTING DATE. THIS SIMULATES A PRE SPRING ADJUSTMENT.
      IF ((ORG .EQ. 3) .AND. (CLS .EQ. 6)) CDU=-0.4
C
      WRITE(12,REC=ORGOFF(ORG)) CLS,CSTG,CDU,DAY,10
   END DO
C
   RETURN
   END
C
C
SUBROUTINE INDATA(DAYS)
C  PROMPTS FOR MAX AND MIN TEMPERATURE DATA;
C  SAVES DATA IN TEMPERATURE VECTORS
   INTEGER FIRST,LAST
   PARAMETER (FIRST=92,LAST=274)
C
   INTEGER DAYS,ERRCOUNT,RR,SOFF
   INTEGER MONTH(1:12),DTOM(1:366)
   REAL    MX,MN,MAXT(FIRST:LAST),MINT(FIRST:LAST),R
   COMMON /CAL/DTOM,MONTH   /TEMPBLK/MAXT,MINT
C
   ERRCOUNT=0
   WRITE(6,*) 'ENTER MAX AND MIN TEMP.'
 100 READ(5,*,ERR=200) MX,MN
   GOTO 300
C
 200 WRITE(6,*) ' ERROR. TEMPS MUST APPEAR AS 2 DECIMALS.'
   ERRCOUNT=ERRCOUNT+1
   IF (ERRCOUNT .GT. 4) GOTO 500
   GOTO 100
C
C  STORE DATA
 300 MAXT(DAYS)=MX
   MINT(DAYS)=MN
   RETURN
 500 WRITE(6,*) ' ERROR LIMIT EXCEEDED. DATA INPUT HALTED.'
   RETURN
   END
C  END OF SUBROUTINE INDATA
C
C
C     HOST ROUTINE
C
   INTEGER FIRST,LAST,START,FINISH
   PARAMETER (FIRST=92,LAST=274,START=401,FINISH=930,NORGS=3)
   INTEGER ERRCOUNT,DD,MM,YY,MD,DAYS,I,MINDAY,MRD
   INTEGER MONTH(1:12),DTOM(1:366),ORGOFF(1:NORGS+1)
   LOGICAL MORE,OK,TDATA,PROMPT
   CHARACTER ANS*1,C1*16
   REAL R1,MAXT(FIRST:LAST),MINT(FIRST:LAST)
   DATA MONTH/0,31,60,91,121,152,182,213,244,274,305,335/
   DATA DTOM/31*1,29*2,31*3,30*4,31*5,30*6,31*7,31*8,
     1          30*9,31*10,30*11,31*12/
```

```
      COMMON /CAL/DTOM,MONTH /TEMPBLK/MAXT,MINT
C
C     OPEN TEMPERATURE FILE
      OPEN(11,FILE='TMP',STATUS='OLD',ACCESS='DIRECT')
      READ(11'1) (MAXT(I),I=FIRST,LAST)
      READ(11'2) (MINT(I),I=FIRST,LAST)
C
      MINDAY=367
C
C     PROMPT FOR YESTERDAY'S TEMPERATURES
      TDATA=PROMPT('YESTERDAY''S')
      IF (TDATA) THEN
           CALL IDATE(MM,DD,YY)
           DAYS=MONTH(MM)+DD-1
           CALL INDATA(DAYS)
      END IF
C
C     PROMPT FOR OTHER DAYS' TEMPERATURES
      TDATA=PROMPT('OTHER DAY''S')
      IF (TDATA) THEN
           MORE=.TRUE.
           ERRCOUNT=0
           DO WHILE (MORE)
  100           WRITE(6,*) ' DATE=MONTH DAY'
                READ(5,501,ERR=200) MD
  501           FORMAT(I60)
                IF ((MD.GT.FINISH).OR.((MD.GT.0).AND.(MD.LE.99)))
     1               GOTO 200
                IF ((MD.LE.FINISH).AND.(MD.GE.START)) THEN
                     I=MD/100
                     DAYS=MONTH(I)+MD-100*I
                     MINDAY=MIN(MINDAY,DAYS)
                     CALL INDATA(DAYS)
                     ERRCOUNT=0
                ELSE
                     MORE=.FALSE.
                END IF
                GOTO 300
  200           WRITE(6,*) 'ERROR. DATE MUST BE A 4 DIGIT INTEGER.'
                ERRCOUNT=ERRCOUNT+1
                IF (ERRCOUNT .LE. 4)  GOTO 300
                WRITE(6,*) 'ERROR LIMIT EXCEEDED. INPUT STOP.'
                MORE=.FALSE.
  300           CONTINUE
           END DO
      END IF
C
C     SAVE TEMPERATURE DATA
      WRITE(11'1) (MAXT(I),I=FIRST,LAST)
      WRITE(11'2) (MINT(I),I=FIRST,LAST)
      CLOSE(UNIT=11,STATUS='KEEP')
C
      OPEN(12,FILE='LFSTG',STATUS='OLD',ACCESS='DIRECT')
      READ(12'1) (ORGOFF(I),I=1,NORGS)
      READ(12,REC=ORGOFF(1)) DD,C1,R1,MRD,MM
      IF (MINDAY.LT.MRD) CALL RESET(START,FINISH,MINDAY,NORGS,ORGOFF)
      CLOSE(12,STATUS='KEEP')
C
      STOP ' '
      END
C     END OF PROGRAM ENTERDATA
```

```
C       6.4    DEVELOP.FOR
C
C       PROGRAM DEVELOP
C       THIS PROGRAM COMPUTES THE DEVELOPMENT OF THE CURRENT
C       ORGANISM USING A TEMPERATURE DRIVEN GROWTH ALGORITHM.
C       HARCOURT & YEE "POLYNOMIAL ALGORITHM FOR PREDICTING THE
C                       DURATION OF INSECT LIFE STAGES"
C                     ENVIRON. ENTOMOL. 11:581-4 1982
C
C
        REAL FUNCTION RATE(A,M,T)
C            CUBIC POLYNOMIAL DEVELOPMENT FUNCTION. DEVELOPMENT
C            RATE IS A FUNCTION OF TEMPERATURE.
C            A - AMPLITUDE OF TEMPERATURE FUNCTION
C            M - MEAN TEMPERATURE
C            T - TIME OF DAY ( HRS )
C
             REAL    A,M,T,CF(0:3),CMAT(1:23,0:5),SLOPE,TMIN,R,TT,TEMP
             INTEGER I
             COMMON  /POLYBLK/CMAT,CF,SLOPE,TMIN
C
C            SKEWS TEMPERATURE CURVE SO MINIMUM OCCURS AT 0600
C            AND MAXIMUM OCCURS AT 1500
             TT=T
             IF (T .GT.  6) TT=(1.333333*T)-2.0
             IF (T .GT. 15) TT=(0.6666667*T)+8.0
C
             TEMP=M-A*SIN(0.261799*TT)
             IF (TEMP .LT. 0.0)  TEMP=0.0
             IF (TEMP .GT. TMIN) THEN
                 R=CF(0)+TEMP*(CF(1)+TEMP*(CF(2)+TEMP*CF(3)))
             ELSE
                 R=SLOPE*TEMP
             END IF
C
             IF (R .LT. 0.0) R=0.0
             RATE = R
             RETURN
             END
C            END OF FUNTION RATE
C
C
        SUBROUTINE ACCUMULATE(DAYLIM,MRD,STG,ORG)
C            ACCUMULATES DEVELOPMENTAL UNITS ( DU'S )
C            DU IN 1 DAY = TIME INTEGRAL OF GROWTH RATE FUNCTION OVER 1 DAY
C
             INTEGER FIRST,LAST
             PARAMETER (FIRST=92,LAST=274)
C
             INTEGER DAYLIM,MRD,ORG
             INTEGER I,J,DAYS,CLS,MM,DD,MD,PRED,OBS,ISTG,SOFF,
     2               MONTH(1:12),DTOM(1:366),ORGOFF(1:3),POLYOFF(1:3)
             REAL    COEF(0:3),CMAT(1:23,0:5),MINTEMP(FIRST:LAST),
     1               MAXTEMP(FIRST:LAST),CDU,T,SLOPE,TMIN,H,A,M
             CHARACTER*16 STG
             COMMON /LSPARM/CLS,CDU /TEMPBLK/MINTEMP,MAXTEMP
             COMMON /POLYBLK/CMAT,COEF,SLOPE,TMIN /CAL/DTOM,MONTH
             COMMON /OFFSET/SOFF,ORGOFF,POLYOFF
C
C            H=SUMMATION STEP SIZE IN HOURS
             H=3.0
```

```
      DAYS=MRD+1
      DO WHILE (DAYS .LE. DAYLIM)
            A=(MAXTEMP(DAYS)-MINTEMP(DAYS))*0.5
            M=MINTEMP(DAYS)+A
            T=0.0
            DO WHILE (T .LT. 24.0)
                  CDU=CDU+H*(RATE(A,M,T)+4*RATE(A,M,T+H/2.0)+
     1                        RATE(A,M,T+H))/144.0
                  T=T+H
                  IF (CDU .GE. 1.0) THEN
                      CLS=CLS+1
                      CDU=0.0
                      ISTG=CLS+POLYOFF(ORG)
                      IF (ORG.EQ.3) THEN
                          K=MOD(CLS,7)
                          IF (K.EQ.0) K=7
                          ISTG=K+POLYOFF(ORG)
                      END IF
                      DO I=0,3
                          COEF(I)=CMAT(ISTG,I)
                      END DO
                      SLOPE=CMAT(ISTG,4)
                      TMIN=CMAT(ISTG,5)
                      I=DAYS
                      IF (T .GT. 15.0) I=DAYS+1
                      MM=DTOM(I)
                      DD=I-MONTH(MM)
                      MD=100*MM+DD
                      J=CLS+ORGOFF(ORG)
                      READ(12,REC=J,ERR=100) STG,PRED,OBS
                      WRITE(12,REC=CLS+ORGOFF(ORG)) STG,MD,OBS
                  END IF
            END DO
            DAYS=DAYS+1
      END DO
100   RETURN
      END
C     END OF SUBROUTINE ACCUMULATE
C
C
      INTEGER FIRST,LAST
      PARAMETER (FIRST=92,LAST=274,NORGS=3)
      INTEGER CLS,CCLS,MRD,YESTERDAY,I,NEXTDAY,MM,DD,YY,ISTG,SOFF,ORG
      INTEGER ORGOFF(1:NORGS),POLYOFF(1:NORGS),MONTH(1:12),DTOM(1:366)
      REAL    MINTEMP(FIRST:LAST),MAXTEMP(FIRST:LAST)
      REAL    MAXT,MINT,SLOPE,TMIN,CCDU,CDU,COEF(0:3),CMAT(1:23,0:5)
      CHARACTER*16 STG,CSTG
      DATA MONTH/0,31,60,91,121,152,182,213,244,274,305,335/
      DATA DTOM/31*1,29*2,31*3,30*4,31*5,30*6,31*7,31*8,
     1          30*9,31*10,30*11,31*12/
      DATA
C         ALFALFA
C         COEFFICIENTS FROM ALFALFA HEAT UNIT DEVELOPMENT
C         DATA FROM HARCOURT ( UNPUBLISHED )
C         CMAT(J,*) STAGE
C               1    PRE BUD
C               2    EARLY BUD
C               3    MID BUD
C               4    LATE BUD
C               5    EARLY BLOOM
C               6    LATE BLOOM
```

```
C                 7     FULL FLOWER
      1     (CMAT( 1,I),I=0,5)/-0.0149521,0.00299043,0.0,0.0,0.0,5.0/
      2     (CMAT( 2,I),I=0,5)/-0.075757576,0.015151515,0.0,0.0,0.0,5.0/
      3     (CMAT( 3,I),I=0,5)/-0.075757576,0.015151515,0.0,0.0,0.0,5.0/
      4     (CMAT( 4,I),I=0,5)/-0.075757576,0.015151515,0.0,0.0,0.0,5.0/
      5     (CMAT( 5,I),I=0,5)/-0.075757576,0.015151515,0.0,0.0,0.0,5.0/
      6     (CMAT( 6,I),I=0,5)/-0.075757576,0.015151515,0.0,0.0,0.0,5.0/
      7     (CMAT( 7,I),I=0,5)/0.002,0.0,0.0,0.0,0.0,5.0/
       DATA
C          WEEVIL
C          COEFFICIENTS FROM
C          HARCOURT & YEE "POLYNOMIAL ALGORITHM FOR PREDICTING THE
C                          DURATION OF INSECT LIFE STAGES"
C                         ENVIRON. ENTOMOL. 11:581-4 1982
C          CMAT(J,*) STAGE
C                 8     EGG ( 50% OF TOTAL EGG-INSTAR 1 STAGE )
C                 9     HATCH ( 50% OF TOTAL EGG-INSTAR 1 STAGE )
C                10     LARVAL INSTAR 1
C                11     LARVAL INSTAR 2
C                12     LARVAL INSTAR 3
C                13     LARVAL INSTAR 4
C                14     COCOON ( 83.333% OF TOTAL PUPA-ADULT STAGE )
C                15     ADULT EMERGENCE ( 16.667% OF TOTAL PUPA-ADULT STAGE )
C                16     ADULT
      1     (CMAT( 8,I),I=0,5)/-0.052786,0.0058651,0.0,0.0,0.0,9.0/
      2     (CMAT( 9,I),I=0,5)/0.14588,-0.03076,0.0030498,-2.586E-5,
      2                        0.00997,6.0/
      3     (CMAT(10,I),I=0,5)/0.07294,-0.01538,0.0015249,-1.293E-5,
      3                        0.005,6.0/
      4     (CMAT(11,I),I=0,5)/-0.0053838,0.005996,-8.5058E-5,
      4                        2.0124E-5,0.00435,8.0/
      5     (CMAT(12,I),I=0,5)/0.12049,-0.025729,0.0021796,-3.013E-5,
      5                        0.0038,8.0/
      6     (CMAT(13,I),I=0,5)/-0.13123,0.023465,-9.3071E-4,2.5595E-5,
      6                        0.00358,10.0/
      7     (CMAT(14,I),I=0,5)/0.24988,-0.039503,0.0021484,-2.74E-5,
      7                        0.00316,12.0/
      8     (CMAT(15,I),I=0,5)/1.2494,-0.19751,0.010742,-1.37E-4,
      8                        0.01578,12.0/
      9     (CMAT(16,I),I=0,5)/0.002,0.0,0.0,0.0,0.0,10.0/
       DATA
C          BLOTCH LEAFMINER
C          COEFFICIENTS FROM
C          J.C. GUPPY "BIONOMICS OF THE ALFALFA BLOTCH LEAFMINER
C                      AGROMYZA FRONTELLA ( DIPTERA : AGROMYZIDAE )
C                      IN EASTERN ONTARIO"
C                     CAN ENTOMOL. 113:593-600 1981
C          AND OTTAWA 1981 FIELD DATA
C          CMAT(J,*) STAGE
C                17     ADULT
C                18     EGG ( TO 50% HATCH OF EGGS )
C                19     HATCH ( FROM 50% HATCH OF EGGS TO LARVA INSTAR 1 )
C                20     LARVA ( INCLUDES INSTARS 1 TO 3 )
C                21     LARVA DROP ( 85% OF TOTAL LARVA-PUPA STAGE )
C                22     PUPA ( 85% OF TOTAL PUPA-ADULT STAGE )
C                23     ADULT EMERGENCE ( 15% OF TOTAL PUPA-ADULT STAGE )
      1     (CMAT(17,I),I=0,5)/0.25,0.0,0.0,0.0,0.05,5.0/
      2     (CMAT(18,I),I=0,5)/1.71046,-0.338647,0.0225556,-4.38581E-4,
      2                        0.0,5.0/
      3     (CMAT(19,I),I=0,5)/1.20413,-0.231328,0.015246,-2.9554E-4,
      3                        0.011992,10.0/
```

```
     4      (CMAT(20,I),I=0,5)/0.70831,-0.136075,0.008968,-0.17385E-03,
     4                         0.007054,10.0/
     5      (CMAT(21,I),I=0,5)/4.01377,-0.771093,0.050820,-0.98513E-03,
     5                         0.039970,10.0/
     6      (CMAT(22,I),I=0,5)/0.254240,-0.0500297,0.00335937,-6.5754E-5,
     6                         0.0024126,10.0/
     7      (CMAT(23,I),I=0,5)/1.44069,-0.283502,0.0190365,-3.72607E-4,
     7                         0.013672,10.0/
C
      DATA SOFF/1/ POLYOFF/0,7,16/
      COMMON /LSPARM/CLS,CDU /POLYBLK/CMAT,COEF,SLOPE,TMIN
      COMMON  /TEMPBLK/MINTEMP,MAXTEMP /CAL/DTOM,MONTH
      COMMON /OFFSET/SOFF,ORGOFF,POLYOFF
C
C     OPEN FILES
      OPEN(UNIT=11,FILE='TMP',STATUS='OLD',ACCESS='DIRECT',READONLY)
      OPEN(UNIT=12,FILE='LFSTG',STATUS='OLD',ACCESS='DIRECT')
C
C     INITIALIZE
C     TEMPERATURE
      READ(11'1) (MAXTEMP(I),I=FIRST,LAST)
      READ(11'2) (MINTEMP(I),I=FIRST,LAST)
C     ORGANISM LIFE STAGE DATA BLOCK ADDRESSES ( = OFFSETS+1 )
      READ(12'1) (ORGOFF(I),I=1,NORGS)
C     YESTERDAY IN DAYS
      CALL IDATE(MM,DD,YY)
D     READ(16,161) MM,DD,YY
D 161 FORMAT(3I2)
      YESTERDAY=MONTH(MM)+DD-1
C
C     ORGANISM LOOP
      DO ORG =1,NORGS
C     LIFE STAGES
      READ(UNIT=12,REC=ORGOFF(ORG)) CLS,STG,CDU,MRD,I
C
C     POLYNOMIAL COEFFICIENTS ETC.
      ISTG=CLS+POLYOFF(ORG)
C
C     BLOTCH LEAFMINER GIVES A LITTLE PROBLEM. MULTIPLE GENERATIONS
C     IMPLY LIFE STAGE DEVELOPMENT COEFFICIENTS CAN BE
C     REUSED FROM GENERATION TO GENERATION. MOD FUNCTION ALLOWS
C     "RECYCLING" OF COEFFICIENTS. OVERWINTERING PUPAE HAVE DIFFERENT
C     COEFFICIENTS BECAUSE THEY COMPLETE DEVELOPMENT AT CDU = 1.4
C     USING APRIL 1 START AND SUMMER PUPA COEFFICIENTS.
      IF (ORG.EQ.3) THEN
          I=MOD(CLS,7)
          IF (I.EQ.0) I=7
          ISTG=I+POLYOFF(ORG)
      END IF
      DO I=0,3
          COEF(I)=CMAT(ISTG,I)
      END DO
      SLOPE=CMAT(ISTG,4)
      TMIN=CMAT(ISTG,5)
C
C     DEVELOPMENTAL THRESHOLD FOR ABL OVERWINTERED PUPAE
C     W.K. MELLORS "A COMPUTER SIMULATION MODEL FOR THE ALFALFA
C     BLOTCH MINER" CORNELL UNIV. AGRIC. EXPER. STN., NO.20, 1981
      IF ((ORG.EQ.3) .AND. (CLS.EQ.6)) THEN
          SLOPE=0.0
          TMIN=6.0
```

```
C           NOTE: MELLORS'S TMIN VALUE IS REALLY 5.6
        END IF
C
C       ACCUMULATE DEVELOPMENT UP TO TODAY
        CALL ACCUMULATE(YESTERDAY,MRD,STG,ORG)
        CCDU=CDU
        CCLS=CLS
        CSTG=STG
C
C       PREDICT DATE OF NEXT STAGE PEAK
        I=YESTERDAY+1
        DO WHILE ((CLS .LE. CCLS) .AND. (I .LE. LAST))
            CALL ACCUMULATE(I,I-1,STG,ORG)
 200        I=I+1
        END DO
        NEXTDAY=MAX(0,I-YESTERDAY-2)
        IF (CLS.LE.CCLS) THEN
            READ(UNIT=12,REC=ORGOFF(ORG)+CCLS) STG,MM,DD
C           PEAK DATE IN MM; LET DD=JULIAN DATE OF PEAK DATE
            DD=MONTH(MM/100)+MOD(MM,100)
            NEXTDAY=50
            IF (CDU.GT.0.0) NEXTDAY=((I-DD)/CDU)+DD-YESTERDAY-1
        END IF
C
C       STORE VARIABLES
        WRITE(UNIT=12,REC=ORGOFF(ORG)) CCLS,CSTG,CCDU,YESTERDAY,NEXTDAY
C
        END DO
C       END OF ORGANISM LOOP
C
        CLOSE(UNIT=11,STATUS='KEEP')
        CLOSE(UNIT=12,STATUS='KEEP')
C
        STOP ' '
        END
C       END OF PROGRAM DEVELOP
```

```
C       6.5     REPORT.FOR
C
C       PROGRAM REPORT
C       THIS PROGRAM PRINTS OUT THE STATUS OF THE ALFALFA CROP,
C       WEEVIL AND BLOTCH LEAFMINER AT THE CURRENT LOCATION.
C
        SUBROUTINE ABLLUMP(STG,CDU,NSTG,CLS,ND,PERCENT)
C          LUMPS ABL STAGES TOGETHER FOR THE PRINTOUT,
C          HATCH INTO EGG STAGE
C          LARVA DROP INTO LARVA STAGE
C          ADULT EMERGENCE INTO PUPA STAGE
C
           CHARACTER*16 STG,NSTG
           INTEGER      CLS,ND,PERCENT
           REAL         CDU
           CHARACTER*6  CSTG(1:7),CNSTG(1:7),G(0:4)*2
           INTEGER      I,K,GEN,SND(1:7)
           REAL         BASE(1:7),F(1:7)
           DATA CSTG/'ADULT ','  EGG ','  EGG ','LARVA ','LARVA ',
     2                ' PUPA ',' PUPA '/
           DATA CNSTG/'  EGG ','LARVA ','LARVA ',' PUPA ',' PUPA ',
     2                'ADULT ','ADULT '/
           DATA G/'G0','G1','G2','G3','G4'/
C
C          SND   - NUMBER OF DAYS TO ADD TO NEXTDAY ( ND ) IN ORDER TO
C                  PREDICT TIME TO NEXT REPORTED STAGE;
C                  E.G. IF CURRENT STAGE = PUPA, REPORT MUST JUMP OVER
C                       ADULT EMERGENCE STAGE TO ADULT STAGE, THUS
C                       REPORT MUST ADD IN DURATION OF EMERGENCE-TO-ADULT
C                       INTERVAL TO PREDICT TIME TO ADULT PEAK
C          F     - WEIGHT OF CURRENT STAGE IN ITS CONTRIBUTION TO
C                  LUMPED STAGE
C                  E.G. IF CURRENT STAGE = HATCH, F = 50% BECAUSE HATCH
C                       FORMS 50% OF THE TOTAL EGG-LARVA INTERVAL ( WHICH
C                       MAKES UP THE REPORTED EGG STAGE )
C          BASE  - PERCENT DEVELOPMENT WHICH MUST BE ADDED TO THE WEIGHTED
C                  DEVELOPMENT OF THE CURRENT STAGE TO GET PERCENT
C                  DEVELOPMENT OF THE LUMPED REPORTED STAGE
C                  EQUIVALENTLY, BASE = CUMULATIVE DEVELOPMENT OF LUMPED
C                  STAGE UP TO THE CURRENT DEVELOPMENTAL STAGE
C                  E.G. IF CURRENT STAGE = HATCH, BASE = 50% BECAUSE
C                       CUMULATIVE DEVELOPMENT OF REPORTED EGG STAGE = 50%,
C                       TO THIS BASE MUST BE ADDED THE WEIGHTED HATCH
C                       DEVELOPMENT ( = 50% * HATCH CDU )
           DATA SND/0,4,0,5,0,3,0/  BASE/0.0,0.0,50.0,0.0,50.0,0.0,85.0/
     2          F/100.0,50.0,50.0,50.0,50.0,85.0,15.0/
C
           K=MOD(CLS,7)
           IF (K.EQ.0) K=7
           GEN=(CLS-K)/7
           STG='        '//CSTG(K)//G(GEN)
           IF (K.GE.6) GEN=GEN+1
           NSTG='        '//CNSTG(K)//G(GEN)
           ND=ND+SND(K)
           PERCENT=BASE(K)+F(K)*CDU
C
           RETURN
           END
C
C
        SUBROUTINE WLUMP(WSTG,WCDU,WNSTG,WCLS,WND,PERCENT)
```

```
C          LUMPS WEEVIL STAGES TOGETHER FOR THE PRINTOUT.
C          HATCH INTO EGG STAGE
C          COCOON INTO PUPA STAGE
C
           CHARACTER*16 WSTG,WNSTG
           INTEGER      WCLS,WND,PERCENT
           REAL         WCDU,BASE(1:8),F(1:8)
           DATA  BASE(1),BASE(2),BASE(7),BASE(8)/0.0,50.0,0.0,83.33333/
     2           F(1),F(2),F(7),F(8)/50.0,50.0,83.33333,16.66667/
C
           IF (WCLS .LT. 3) THEN
               WSTG='              EGG'
               WNSTG=' LARVAL INSTAR 1'
               IF (WCLS .EQ. 1) WND=WND+3
           ELSE
               WSTG='           COCOON'
               WNSTG='            ADULT'
               IF (WCLS .EQ. 7) WND=WND+2
           END IF
           PERCENT=BASE(WCLS)+F(WCLS)*WCDU
           RETURN
           END
C
      SUBROUTINE ADVISE(ORG,CLS,CDU,NUM)
C          SEARCHES FOR APPROPRIATE ADVISORY IN INTERNAL LIST,
C          PRINTS THE ADVISORY.
C
           REAL     CDU
           INTEGER  ORG,CLS,NUM,M,I,AREP(1:7),WREP(1:9),BLREP(6:34),
     2              PTR(1:23)
           CHARACTER*76 REP(1:62)
           DATA  AREP/1,2,2,2,3,4,4/  WREP/5,7,8,9,10,11,12,12,13/
     2           BLREP/14,19,15,16,17,18,14,14,20,15,16,17,18,14,14,
     2                 21,15,16,17,18,14,14,22,15,16,17,18,14,14/
     3           PTR/1,2,3,4,5,6,11,20,22,24,27,36,38,39,
     4               40,46,51,52,54,56,58,60,62/
           DATA REP/
C     ALFALFA ADVISORIES
     1'MAXIMUM PROTEIN LEVELS HAVE NOT BEEN REACHED.',
     2'MAXIMUM PROTEIN LEVELS HAVE BEEN REACHED.',
     3'PROTEIN LEVELS ARE NOW DECLINING.',
     4'PROTEIN LEVELS IN UNCUT ALFALFA CONTINUING TO DECLINE.',
C
C     WEEVIL ADVISORIES
     5'NO SCOUTING REQUIRED.',
     6'CHECK FOR OVIPOSITION PUNCTURES IN STEMS OF ALFALFA GROWING ON',
     6'SOUTHERLY SLOPES. USE EARLY WARNING SYSTEM TO ARRIVE AT A',
     6'TREAT/NO TREAT DECISION. IF NO TREATMENT INDICATED, RESAMPLE',
     6'WITHIN 3 OR 4 DAYS. IF TREATMENT INDICATED, SPRAY IMMEDIATELY',
     6'WITH A PESTICIDE.',
     7'CHECK FOR OVIPOSITION PUNCTURES IN ALFALFA STEMS. USE EARLY',
     7'WARNING SYSTEM TO ARRIVE AT A TREAT/NO TREAT DECISION. ',
     7'IF NO TREATMENT INDICATED, RESAMPLE WITHIN 3 OR 4 DAYS. IF',
     7'TREATMENT INDICATED, HARVEST IMMEDIATELY IF CROP HAS REACHED',
     7'THE BUD STAGE AND THERE IS SUFFICIENT BULK. OTHERWISE SPRAY',
     7'WITH A PESTICIDE.'/'',
     7'CHECK FOR LARVAL FEEDING DAMAGE IN FOLIAGE OF ALFALFA GROWING',
     7'ON SOUTHERLY SLOPES. IF 25% OF STEMS SHOW FEEDING DAMAGE IN',
     7'TIPS, HARVEST OR SPRAY IMMEDIATELY.',
     8'CHECK FOR LARVAL FEEDING DAMAGE IN FOLIAGE. IF 25% OF STEMS',
     8'SHOW FEEDING DAMAGE IN THE TIPS, HARVEST OR SPRAY IMMEDIATELY.',
```

```
12300          9'CHECK FOR LARVAL FEEDING DAMAGE IN FOLIAGE. IF 50% OF STEMS',
12400          9'SHOW FEEDING DAMAGE IN THE TIPS, HARVEST OR SPRAY IMMEDIATELY.',
12500          0'CHECK FOR LARVAL FEEDING DAMAGE IN FOLIAGE. IF 50% OF STEMS',
12600          0'SHOW FEEDING DAMAGE IN THE TIPS, HARVEST OR SPRAY IMMEDIATELY,',
12700          0'UNLESS LARVAL DISEASE IS EVIDENT.',
12800          1'CHECK FOR LARVAL FEEDING DAMAGE IN FOLIAGE. IF 50% OF STEMS',
12900          1'SHOW FEEDING DAMAGE IN THE TIPS AND LARVAL DISEASE IS NOT',
13000          1'EVIDENT, HARVEST OR SPRAY IMMEDIATELY.',
13100          1'DAMAGE WILL REACH ITS PEAK WITHIN '',I2,'' DAYS.',
13200          1'''/''    ***    FOR CROPS CUT WITHIN PAST 10 DAYS    ***''/''',
13300          1'IF POPULATIONS WERE HEAVY AT TIME OF HARVEST, REGROWTH SHOULD',
13400          1'BE CHECKED FOR SIGNS OF CONTINUED FEEDING WHICH CAN RETARD',
13500          1'THE REGROWTH. WHEN THIS OCCURS, THE STUBBLE SHOULD',
13600          1'BE SPRAYED WITH A PESTICIDE.',
13700          2'PEAK DAMAGE HAS NOW OCCURRED. SPRAYING IS NOT WARRANTED.',
13800          2'CONTINUE TO CHECK REGROWTH FOR SIGNS OF FEEDING INJURY.',
13900          3'PEAK DAMAGE HAS NOW OCCURRED. SPRAYING IS NOT WARRANTED.',
14000    C
14100    C     BLOTCH LEAFMINER ADVISORIES
14200          4'NO SCOUTING REQUIRED.',
14300          5'PINHOLING WILL BE EVIDENT IN AREAS OF HIGH INFESTATION.',
14400          5'                STARTING IN '',I2,'' DAYS',
14500          5'USE EARLY WARNING SYSTEM TO ARRIVE AT A TREAT/NOTREAT DECISION.',
14600          5'IF NOTREATMENT INDICATED, RESAMPLE IN 3 OR 4 DAYS. IF TREATMENT',
14700          5'INDICATED, HARVEST IMMEDIATELY IF CROP HAS REACHED BUD STAGE',
14800          5'AND THERE IS SUFFICIENT BULK. OTHERWISE SPRAY WITH A PESTICIDE.',
14900          6'WHERE PINHOLING IS EVIDENT, USE EARLY WARNING SYSTEM TO',
15000          6'ARRIVE AT A TREAT/NO TREAT DECISION. IF NO TREATMENT INDICATED,',
15100          6'RESAMPLE IN 3 OR 4 DAYS. IF TREATMENT INDICATED, HARVEST',
15200          6'IMMEDIATELY IF CROP HAS REACHED THE BUD STAGE AND THERE IS',
15300          6'SUFFICIENT BULK. OTHERWISE SPRAY WITH A PESTICIDE.',
15400          7'IF MINING RATE IS 40%, HARVEST OR SPRAY IMMEDIATELY.',
15500          8'DAMAGE WILL REACH ITS PEAK IN '',I2,'' DAYS. IF 30% OR MORE',
15600          8'OF THE LEAFLETS CONTAIN BLOTCH-TYPE MINES,HARVEST IMMEDIATELY.',
15700          9'EMERGENCE OF FIRST GENERATION ADULTS HAS BEGUN.',
15800          9'NO SCOUTING REQUIRED.',
15900          0'EMERGENCE OF SECOND GENERATION ADULTS HAS BEGUN.',
16000          0'NO SCOUTING REQUIRED.',
16100          1'EMERGENCE OF THIRD GENERATION ADULTS HAS BEGUN.',
16200          1'NO SCOUTING REQUIRED.',
16300          2'EMERGENCE OF FOURTH GENERATION ADULTS HAS BEGUN.',
16400          2'NO SCOUTING REQUIRED.',
16500          3'NOMORE ADVISORIES THIS SEASON.'/
16600    C
16700    C          DETERMINE ADVISORY NUMBER
16800               IF (ORG .EQ. 1) M=AREP(CLS)
16900               IF (ORG .EQ. 2) THEN
17000                   M=WREP(CLS)
17100                   IF ((CLS .EQ. 1) .AND. (CDU .GE. 0.80)) M=6
17200               END IF
17300               IF (ORG .EQ.3) M=BLREP(CLS)
17400    C
17500    C          PRINT ADVISORY NUMBER M
17600               DO I=PTR(M),PTR(M+1)-1
17700                   J=INDEX(REP(I),'''',I2,''')
17800                   IF (J .EQ. 0) THEN
17900                       WRITE(6,'('' '//REP(I)//''')')
18000                   ELSE
18100                       IF (NUM.GE.0) WRITE(6,'('' '//REP(I)//''')') NUM
18200                   END IF
18300               END DO
```

```
18400                 WRITE(6,*) ' '
18500                 RETURN
18600                 END
18700   C
18800   C
18900           PARAMETER (FLOWER=7,HATCH=2,COCOON=7,AE=8,ADULTS=9)
19000           PARAMETER (ENDCROP=630,FINISH=930)
19100           CHARACTER*16 WSTG,WNSTG,ASTG,ANSTG,BLSTG,BLNSTG,TODAY*9,CR*1,LF*1
19200           INTEGER  I,D1,D2,WCLS,WMRD,WND,ACLS,AMRD,AND,AOFF,WOFF,
19300         2          BLCLS,BLMRD,BLND,BLDROP,BLOFF,ND,MMDD,MM,DD,YY,PERCENT
19400           REAL     WCDU,ACDU,BLCDU
19500           DATA     LF,CR/10,13/
19600   C
19700   C       FORMAT STATEMENTS
19800     601 FORMAT(' ',18X,A16,' EXPECTED WITHIN ',I2,' DAYS.')
19900     602 FORMAT('+',38X,'  ; DEVELOPMENT= ',I3,' %')
20000     603 FORMAT(' ',18X,A16,' PEAK EXPECTED WITHIN ',I2,' DAYS.')
20100   C
20200           OPEN(22,FILE='LFSTG',STATUS='OLD',ACCESS='DIRECT',READONLY)
20300           READ(22'1) AOFF,WOFF,BLOFF
20400   C
20500   C       ALFALFA STATUS
20600           READ(22,REC=AOFF) ACLS,ASTG,ACDU,AMRD,AND
20700           READ(22,REC=ACLS+1+AOFF) ANSTG,D1,D2
20800   C
20900   C       ALFALFA WEEVIL STATUS
21000           READ(22,REC=WOFF) WCLS,WSTG,WCDU,WMRD,WND
21100           READ(22,REC=WCLS+1+WOFF) WNSTG,D1,D2
21200   C
21300   C       BLOTCH LEAFMINER STATUS
21400           READ(22,REC=BLOFF) BLCLS,BLSTG,BLCDU,BLMRD,BLND
21500           READ(22,REC=BLCLS+1+BLOFF) BLNSTG,D1,D2
21600   C
21700           CLOSE(22,STATUS='KEEP')
21800   C
21900   C       PRINTOUT
22000           CALL DATE(TODAY)
22100   D       READ(17,1701) TODAY
22200   D1701 FORMAT(A9)
22300           WRITE(6,*) 'STATUS AS OF 00:00H',TODAY,LF
22400   C
22500   C       PAST END OF SEASON
22600           CALL IDATE(MM,DD,YY)
22700   D       READ(16,1601) MM,DD,YY
22800   D1601 FORMAT(3I2)
22900           MMDD=100*MM+DD
23000           IF (MMDD .GE. FINISH) THEN
23100                 WRITE(6,*) 'THE SEASON IS OVER, GOODBYE TIL NEXT YEAR.'
23200                 GOTO 200
23300           END IF
23400   C
23500   C       ALFALFA PRINTOUT
23600   C
23700           IF (MMDD .LE. ENDCROP) THEN
23800                 WRITE(6,*) LF,LF,CR
23900                 WRITE(6,*) 'ALFALFA CROP STAGE :',ASTG
24000                 IF (ACLS .LT. FLOWER) WRITE(6,601) ANSTG,AND
24100                 CALL ADVISE(1,ACLS,ACDU,AMRD)
24200           END IF
24300   C
24400   C       WEEVIL PRINTOUT
```

```
C
      PERCENT=100*WCDU
      IF (WCLS .LE.HATCH)
     2    CALL WLUMP(WSTG,WCDU,WNSTG,WCLS,WND,PERCENT)
      IF ((WCLS.GE.COCOON).AND.(WCLS.LE.AE))
     2    CALL WLUMP(WSTG,WCDU,WNSTG,WCLS,WND,PERCENT)
      WRITE(6,*) LF,LF,CR
      WRITE(6,*) 'ALFALFA WEEVIL STAGE :',WSTG
      IF (WCLS .LT. ADULTS) THEN
          WRITE(6,602) PERCENT
          WRITE(6,603) WNSTG,WND
          CALL ADVISE(2,WCLS,WCDU,WND)
      END IF
C
C     BLOTCH LEAFMINER PRINTOUT
C
      PERCENT=100*BLCDU
      I=MOD(BLCLS,7)
      IF (I.EQ.0) I=7
      IF (I.EQ.4) BLDROP=BLND
      CALL ABLLUMP(BLSTG,BLCDU,BLNSTG,BLCLS,BLND,PERCENT)
      WRITE(6,*) LF,LF,CR
      WRITE(6,*) 'ALFALFA B. L.  STAGE :',BLSTG
      IF ((I.NE.1).AND.(PERCENT.GE.0)) WRITE(6,602) JMAX0(0,PERCENT)
      WRITE(6,603) BLNSTG,BLND
      D1=BLND
      IF (I.EQ.4) D1=BLDROP
C
C     APPROXIMATE NUMBER OF DAYS TO 50% HATCH (>=0).
      IF (I.EQ.1) D1=0.5+(0.5-BLCDU)*BLND
      CALL ADVISE(3,BLCLS,BLCDU,D1)
C
  200 CONTINUE
      STOP ' '
      END
C     END OF PROGRAM REPORT
```

```
C       6.6   UTIL.FOR
C
C       UTILITY PROGRAM FOR WRITEING (CREATING) AND READING
C       SIMWEEVIL DIRECT ACCESS, RELATIVE FILES.
C
        INTEGER     FIRST,LAST
        PARAMETER (FIRST=92,LAST=274,NORGS=3)
        CHARACTER*16 RELFILE,SEQFILE,STG
        INTEGER       I,J,UTILITY,MRD,NXD,CLS,PRED,OBS,ADDRESS(1:18)
        REAL          CDU,S,T,MAXT(FIRST:LAST),MINT(FIRST:LAST)
C
C       MAXT - MAXIMUM TEMP.
C       MINT - MINIMUM TEMP.
C       CLS  - CURRENT LIFE STAGE NUMBER; 1 = EGG, ETC.
C       STG  - STAGE NAME
C       CDU  - CUMULATIVE DEVELOPMENTAL UNITS
C       MRD  - MOST RECENT DAY OF PROCESSING
C       NXD  - NEXT DAY ; PREDICTED NUMBER OF DAYS TO
C                           NEXT LIFE STAGE PEAK
C       PRED - PREDICTED DAY OF LIFE STAGE PEAK
C       OBS  - OBSERVED DAY OF LIFE STAGE PEAK
C
  101   FORMAT(2F6.1)
  102   FORMAT(I3,A16,F6.4,2I3)
  103   FORMAT(A16,2I5)
  104   FORMAT(5F13.9,F5.1)
  107   FORMAT(<NORGS+1>I3)
  501   FORMAT(I60)
  552   FORMAT(A16)
  601   FORMAT(' REC?')
C
 1000   CONTINUE
C
C       WRITE - CREATES A DIRECT ACCESS, RELATIVE FILE FROM DATA
C               STORED IN A SEQUENTIAL FILE ALREADY ON DISK
C       READ  - READS A DIRECT ACCESS, RELATIVE FILE.
C               OUTPUT IS DIRECTED TO STANDARD PRINT UNIT ( FOR006 ).
        WRITE(6,660) 1,2,3,4
  660   FORMAT('          UTILITY CODES'/'          TEMP LIFE'/
     1        ' WRITE',2I5/' READ ',2I5)
        WRITE(6,*) ' UTILITY?'
        READ(5,501) UTILITY
        IF ((UTILITY .LE. 0) .OR. (UTILITY .GT. 4)) GOTO 2000
        WRITE(6,*) ' RELATIVE FILE?'
        READ(5,552) RELFILE
C
        IF (UTILITY .LT. 3) THEN
            WRITE(6,*) ' SEQUENTIAL FILE?'
            READ(5,552) SEQFILE
            IF (UTILITY .EQ. 2) I=8
            IF (UTILITY .EQ. 1) I=2+LAST-FIRST
            OPEN(1,FILE=SEQFILE,STATUS='OLD')
            OPEN(2,FILE=RELFILE,STATUS='NEW',ACCESS='DIRECT',
     1            ORGANIZATION='RELATIVE',RECL=1,INITIALSIZE=3,
     2            EXTENDSIZE=3)
        END IF
C
        IF (UTILITY .GT. 2) THEN
            OPEN(2,FILE=RELFILE,STATUS='OLD',ACCESS='DIRECT')
        END IF
C
```

```
C       CASE STATEMENT TO CHOOSE UTILITY
        GO TO (410,420,430,440),UTILITY
        GOTO 500
C
C       WRITE TEMPERATURE FILE
 410    I=FIRST
 411    READ(1,101,END=412) MAXT(I),MINT(I)
        I=I+1
        GOTO 411
 412    WRITE(2'1) (MAXT(I),I=FIRST,LAST)
        WRITE(2'2) (MINT(I),I=FIRST,LAST)
        GOTO 500
C
C       WRITE LIFE STAGE FILE
 420    READ(1,107) (ADDRESS(I),I=1,NORGS+1)
        WRITE(2'1) (ADDRESS(I),I=1,NORGS+1)
        DO J=1,NORGS
            READ(1,102) CLS,STG,CDU,MRD,NXD
            WRITE(2,REC=ADDRESS(J)) CLS,STG,CDU,MRD,NXD
            DO I=ADDRESS(J)+1,ADDRESS(J+1)-1
                READ(1,103) STG,PRED,OBS
                WRITE(2,REC=I) STG,PRED,OBS
            END DO
        END DO
        GOTO 500
C
C       READ TEMPERATURE FILE
 430    READ(2'1) (MAXT(I),I=FIRST,LAST)
        READ(2'2) (MINT(I),I=FIRST,LAST)
        DO I=FIRST,LAST
            WRITE(6,101) MAXT(I),MINT(I)
        END DO
        GOTO 500
C
C       READ LIFE STAGE FILE
 440    READ(2'1) (ADDRESS(I),I=1,NORGS+1)
        WRITE(6,107) (ADDRESS(I),I=1,NORGS+1)
        DO J=1,NORGS
            READ(2,REC=ADDRESS(J)) CLS,STG,CDU,MRD,NXD
            WRITE(6,102) CLS,STG,CDU,MRD,NXD
            DO I=ADDRESS(J)+1,ADDRESS(J+1)-1
                READ(2,REC=I) STG,PRED,OBS
                WRITE(6,103) STG,PRED,OBS
            END DO
        END DO
        GOTO 500
C
 500    IF (UTILITY .LT. 3) CLOSE(1,STATUS='KEEP')
        CLOSE(2,STATUS='KEEP')
        WRITE(6,*) ' '
        GOTO 1000
 2000   CONTINUE
        STOP 'END UTILITY'
        END
```

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